Case Study #1

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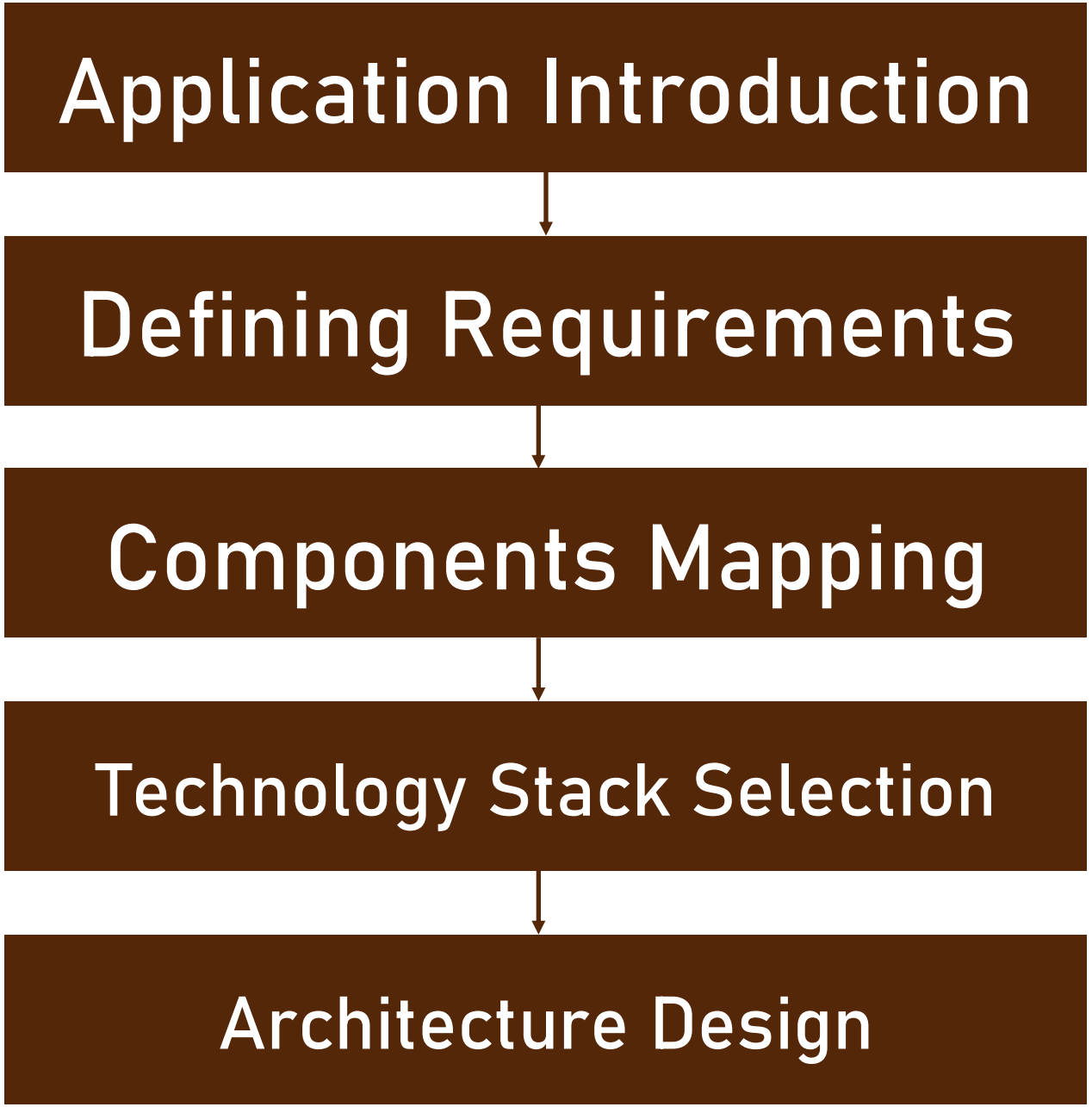
A Real World Application


Application Introduction
Defining Requirements
Components Mapping
Technology Stack Selection
Architecture Design

Dunderly

Your Paper Source

Dunderly

- Sells Paper Supplies
  - Printer paper, Envelopes, etc.
- Needs a new HR system
- Managing employees, salaries, vacations, payments

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Requirements

Functional

What the system should do

1. Web Based
2. Perform CRUD operations on employees
3. Manage Salaries:
    1. Allow manager to ask for employee's salary change
    2. Allow HR manager to approve / reject request
4. Manage vacation days
5. Use external payment system

Non-Functional

What the system should deal with

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NFR - What We Know

1. Classic Information System
2. Not a lot of users
3. Not a lot of data
4. Interface to external system

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NFR - What We Ask

1. *"How many expected concurrent users?"* 10

2. *"How many employees?"* 250

3. "*What do we know about the external Payment system?"*

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Payment System

- Legacy system, written in C++
- Hosted in the company's servers farm
- Input – only files ☹
- File received once a month

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Data Volume

- 1 Employee = ~1MB in data
- Each employee has ~10 scanned documents (contract, reviews etc.)
- 1 Scanned Document =~5MB
- Total storage for 1 employee = ~51MB

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Data Volume – Cont.

- Company expects to grow to 500 employees in 5 years
- Total storage: 51MB X 500 employees = 25.5GB
- Not a lot, but:
  - Need to consider document storage

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SLA

4. "How critical is the system?"

Not Very Critical

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Requirements

Functional

What the system should do

1. Web Based
2. Perform CRUD operations on employees
3. Manage Salaries:
    1. Allow manager to ask for employee's salary change
    2. Allow HR manager to approve / reject request
4. Manage vacation days
5. Use external payment system

Non-Functional

What the system should deal with

1. 10 Concurrent users
2. Manages 500 users
3. Data volume forecast: 25.5GB
    1. Relational & Unstructured
4. Not mission critical
5. File-based interface

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Components

Based on requirements:

1. Entities: Employees, Vacation, Salary
2. Interface to the Payment System

Employees Service → Performs CRUD Operations on Employees

Salary Service → Salary approval workflow

Vacation Service → Employee's Vacation Management

View Service → Returns static files to the browser (HTML, CSS, JS)

Payment System

Payment Interface → Sends payment data to payment system

Data Store

Logging

Q: Single or Per Service Data Store?

A: Data is shared between services, so a Single Data Store is better

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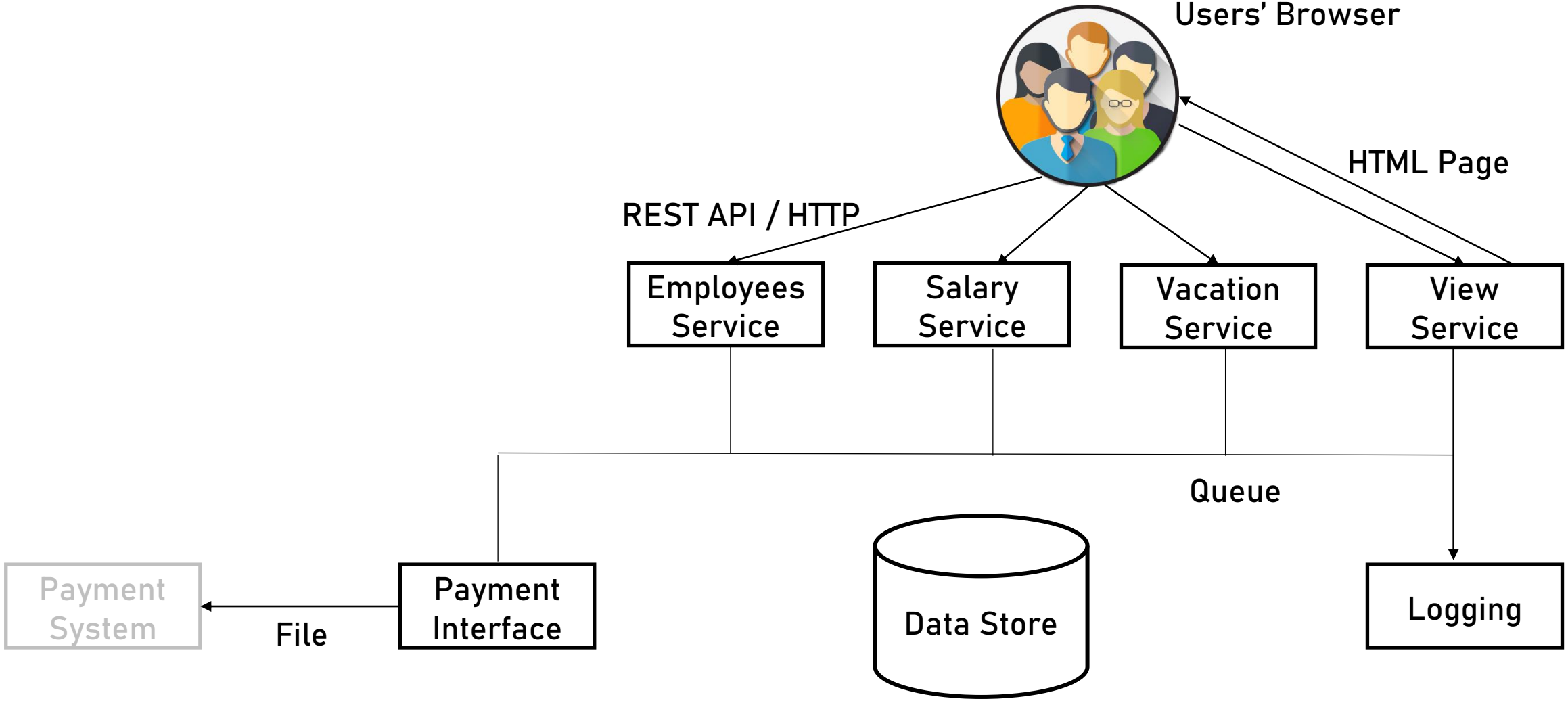
Messaging



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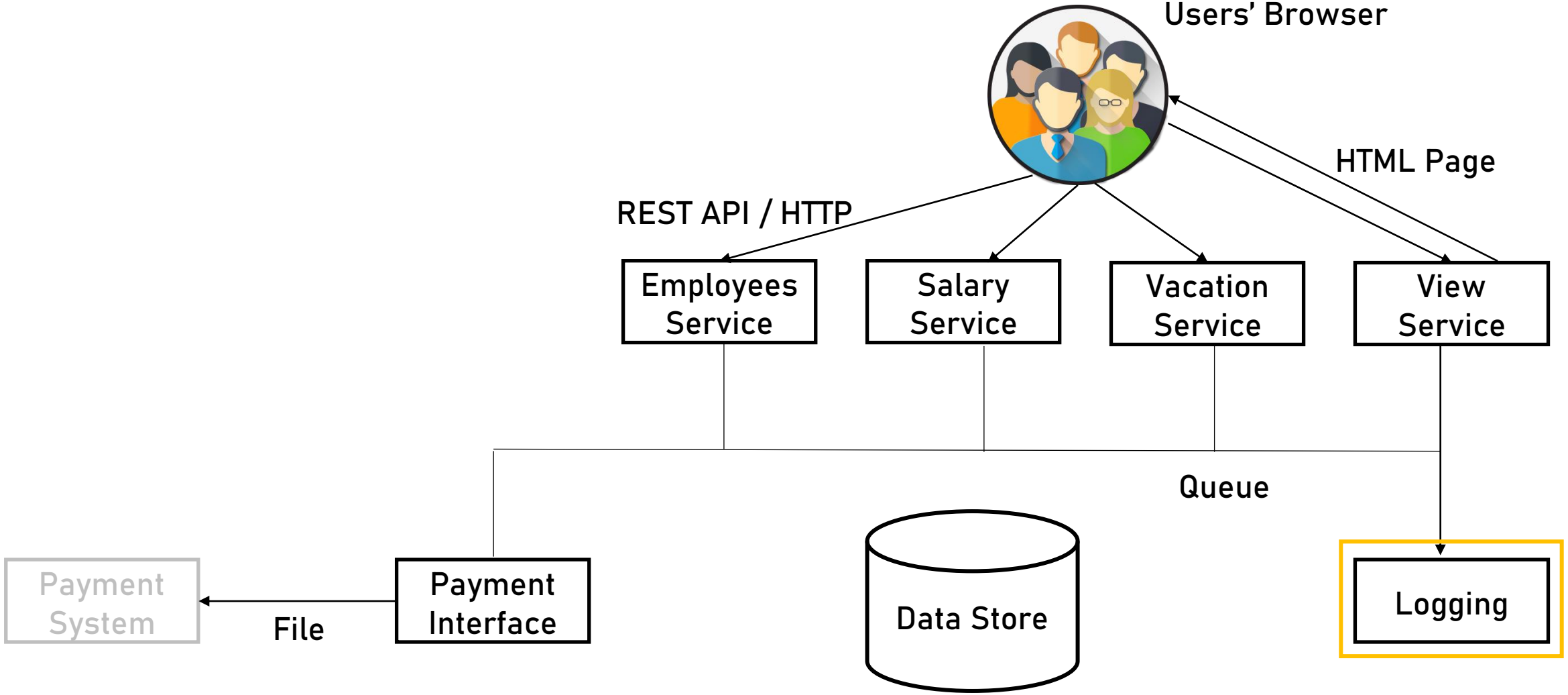
Components



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Logging Service

- Very Important

- Other services use it

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Logging - Questions

1. Is there an existing logging mechanism in the company?

   No

2. Develop our own or use 3rd party?

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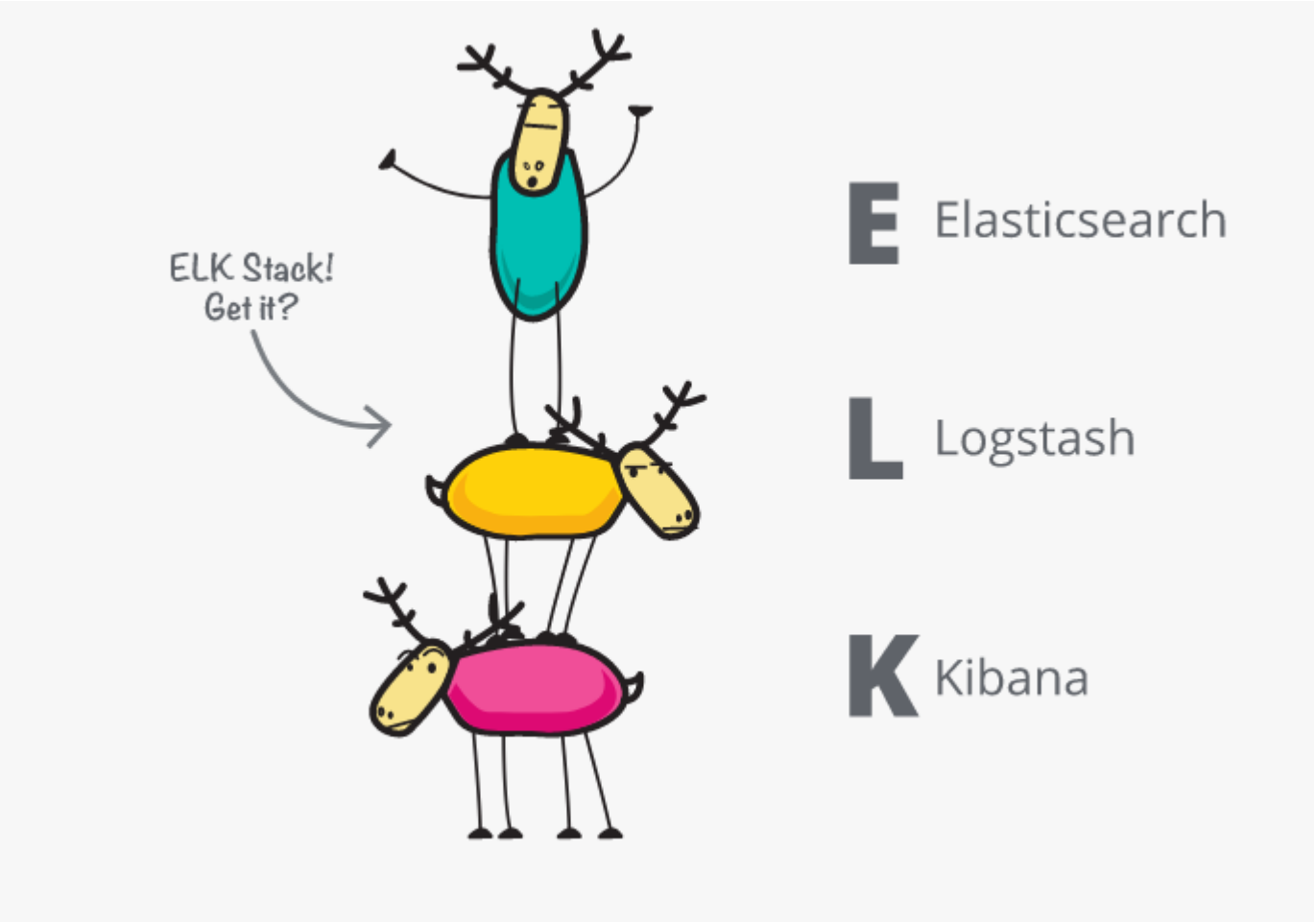
Logging – Alternative



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Logging - Alternative

ELK:

- Powerful data store (Elastic)
- Import log from many sources (Logstash)
- Great viewer with filter capabilities (Kibana)

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Logging - Alternative

But:

- Requires maintenance
- Quite complicated to install and setup
- Suitable mainly for large, data-intensive systems

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Logging Service

Steps:

- Decide on Application Type

- Decide on Technology Stack

- Design the Architecture

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Application Type

What it does:

- Read log records from queue

- Validate the records

- Store in data store

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Application Type

What it does:

- Read log records from queue
- Handle the records
- Save in data store

Application Type

- Web App & Web API ❌
- Mobile App ❌
- Console ❓
- Service ❓
- Desktop App ❌

Application Type

- Web App & Web API ✗
- Mobile App ✗
- Console ✓
- Service ✓
- Desktop App ✗

Technology Stack

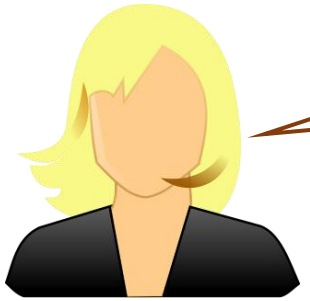
For:

- Component's Code
- Data Store

Technology Stack

Code Should:

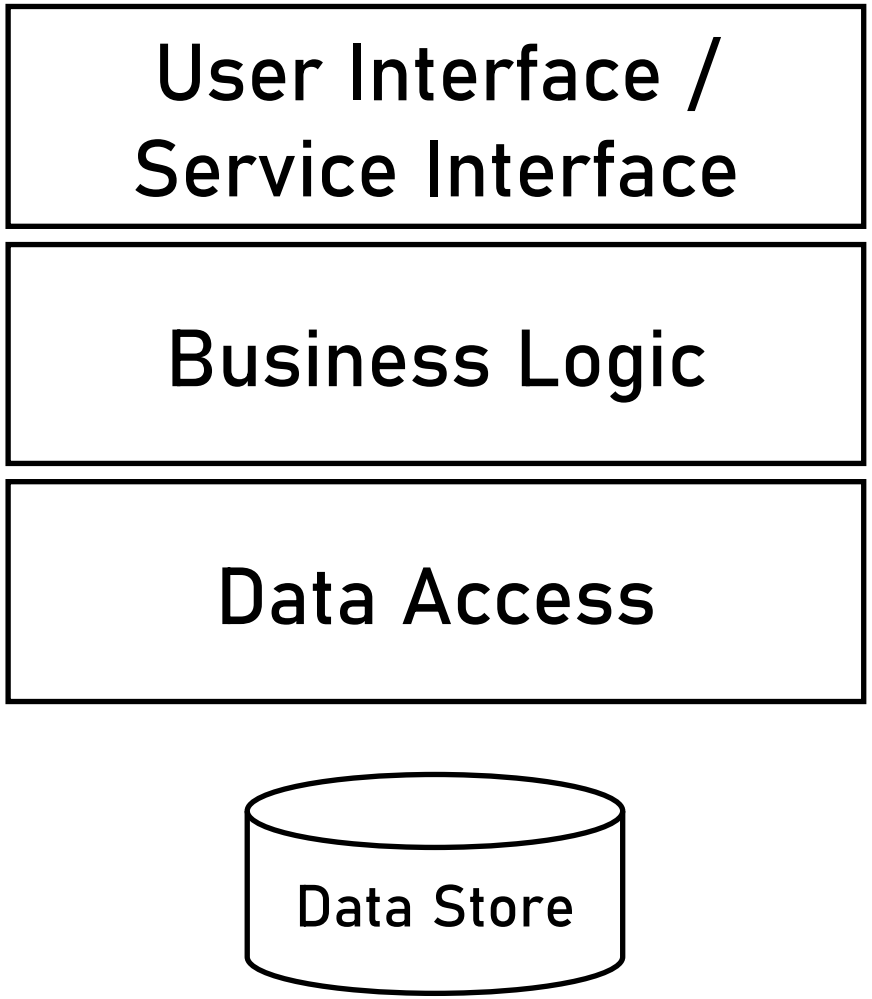
- Access Queue's API
- Validate the data
- Store the data



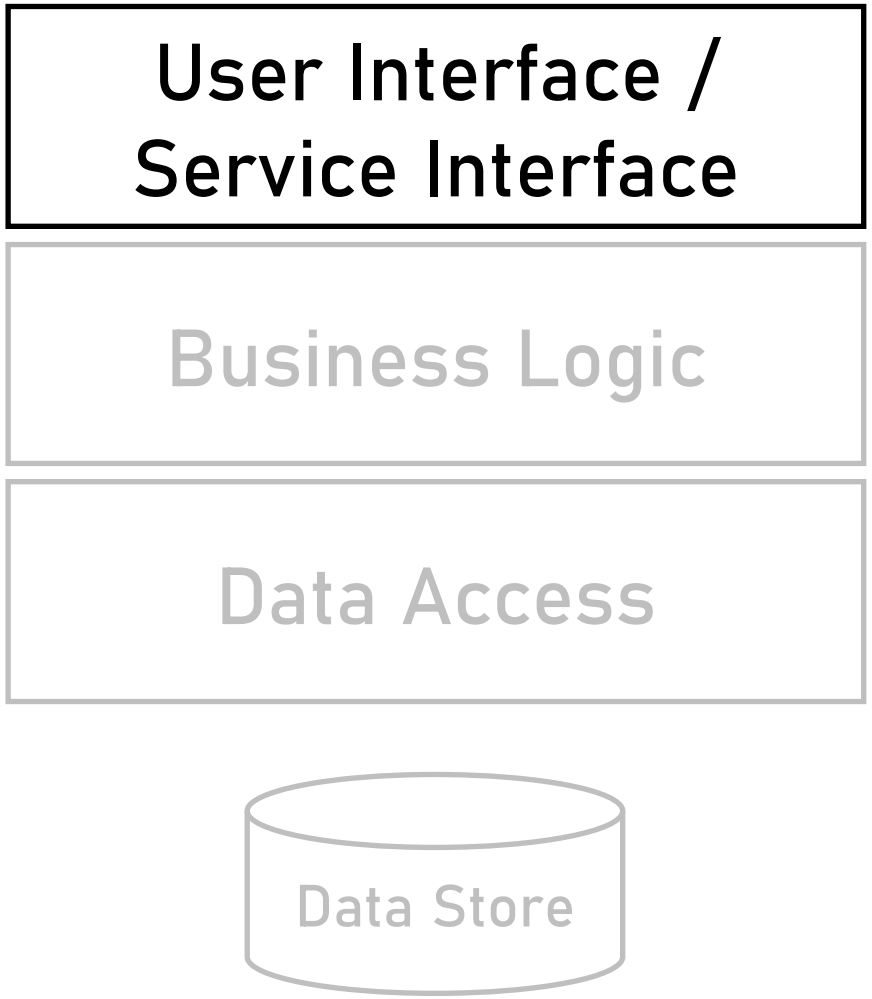
We're familiar with Microsoft stack, so we are expert in .NET and SQL Server

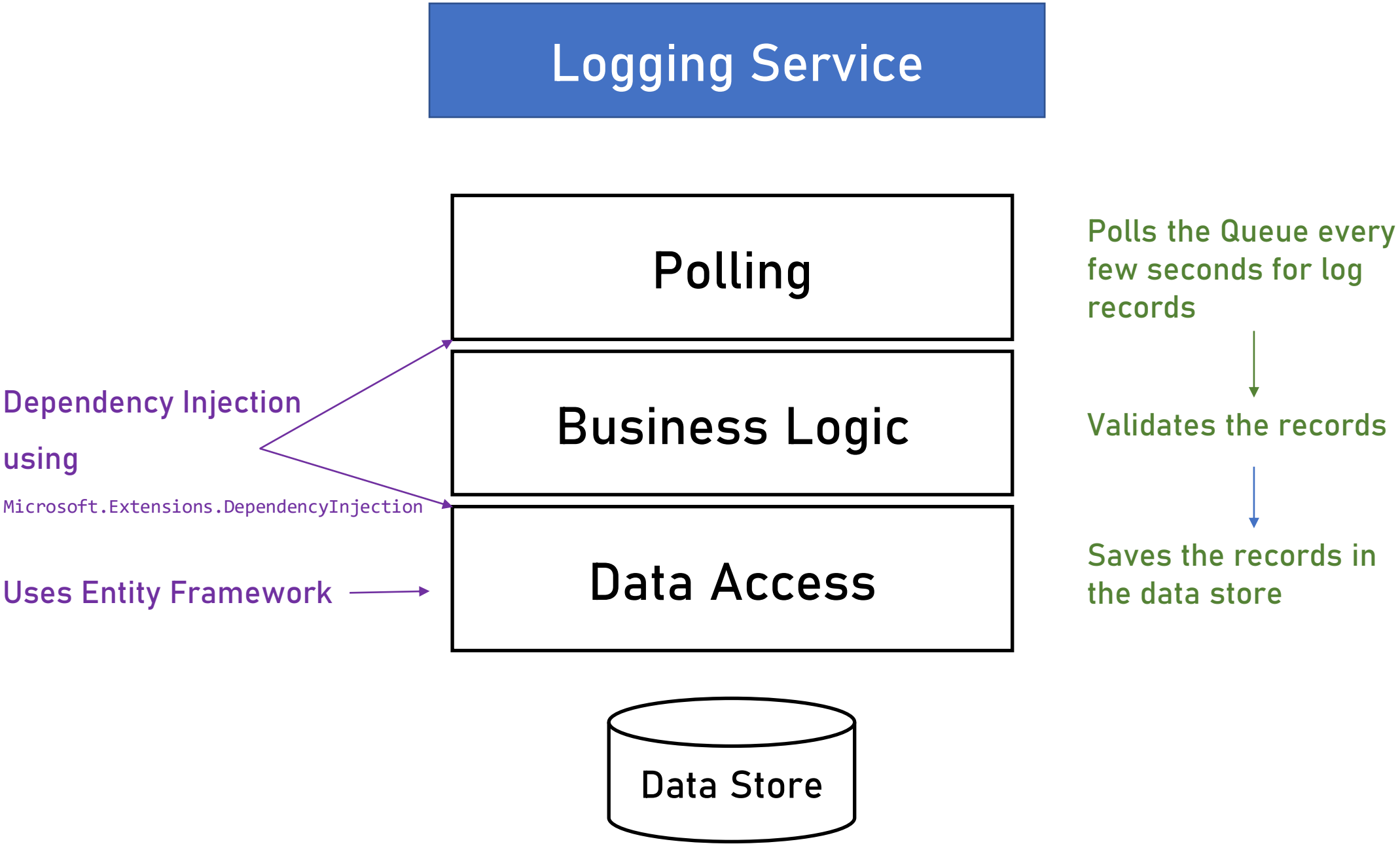
Technology Stack

Architecture



Architecture




Logging Service
Polling
Business Logic
Data Access
Data Store
Dependency Injection using
Microsoft.Extensions.DependencyInjection
Uses Entity Framework
Polls the Queue every few seconds for log records
Validates the records
Saves the records in the data store

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Logging Service Redundancy

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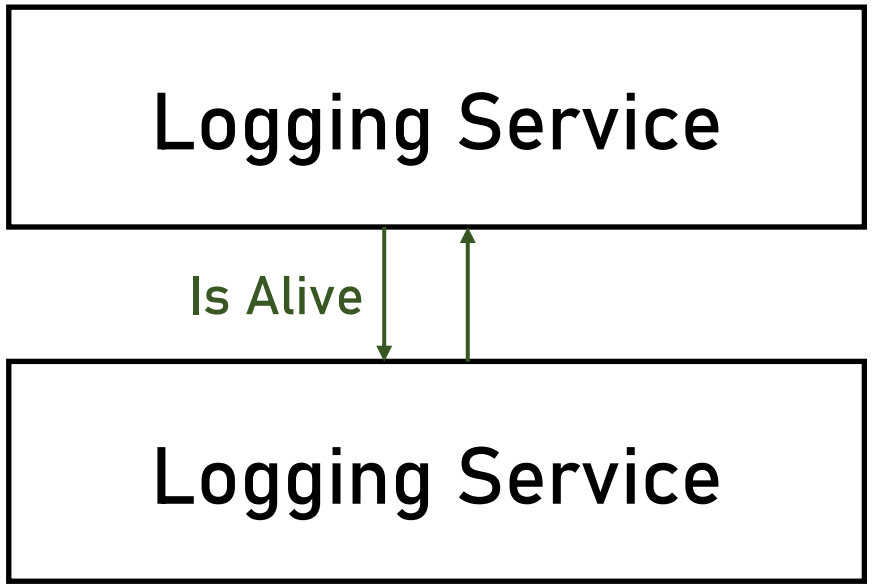
Logging Service Redundancy



- Active / Active
- Avoid duplicate reads?

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Logging Service Redundancy

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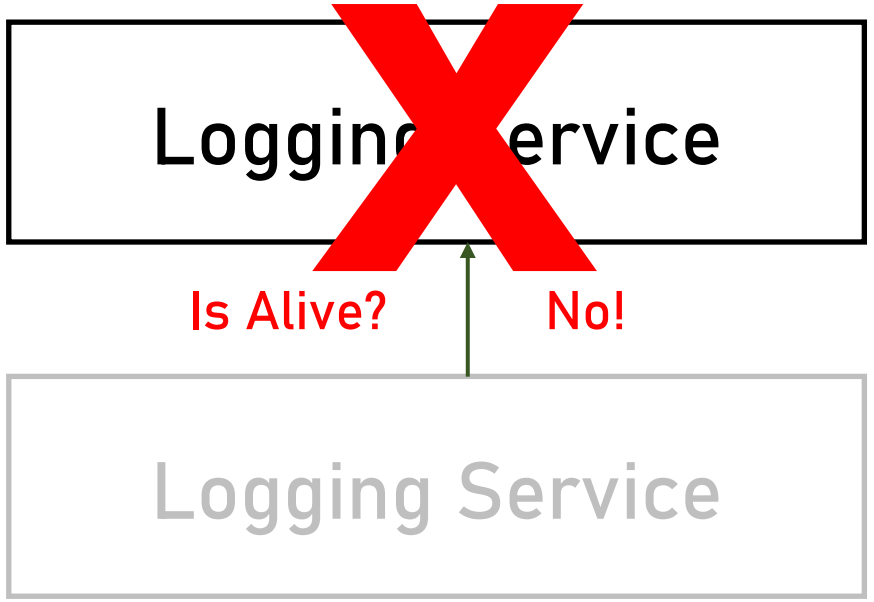
Logging Service Redundancy



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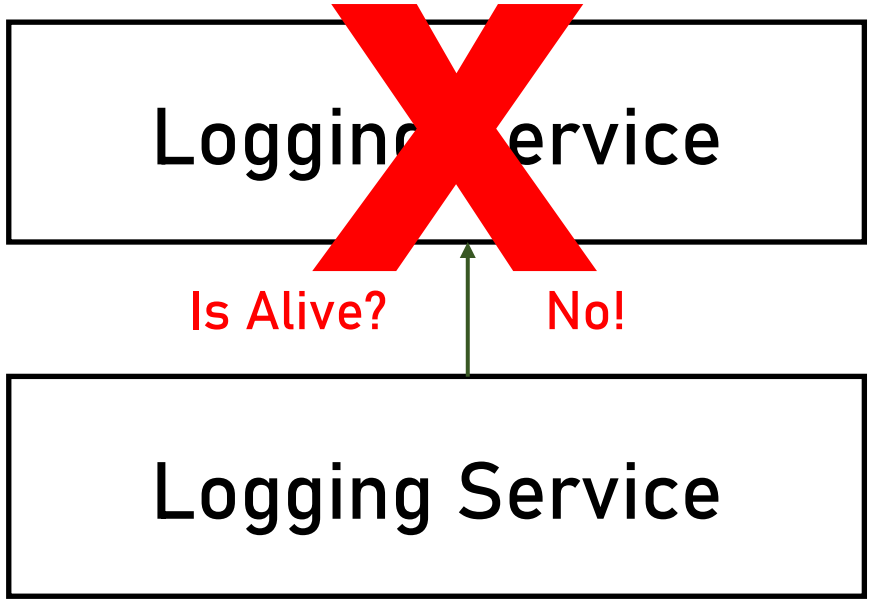
Logging Service Redundancy



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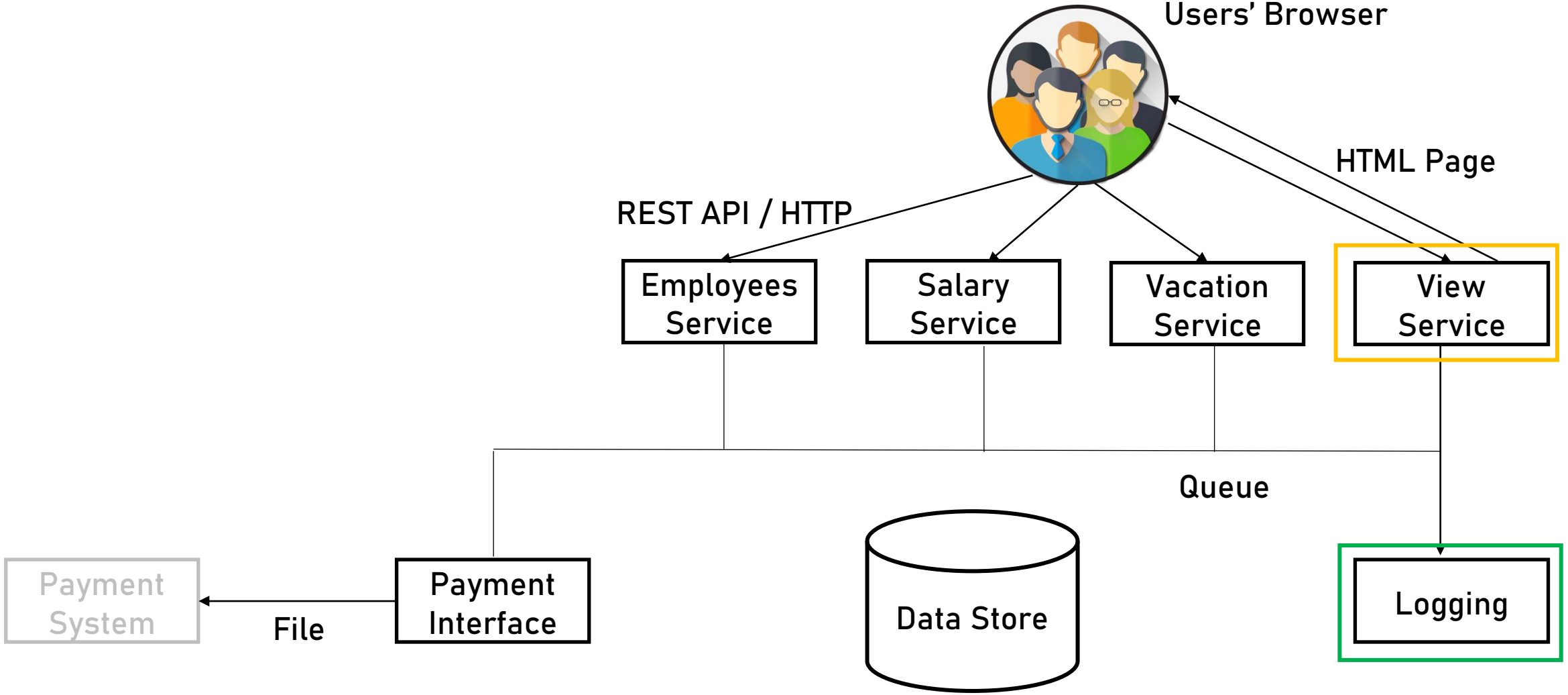
Components



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View Service

What it does:

- Get requests from the end users' browsers

- Returns static files (HTML / CSS / JS)

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Application Type

- Web App & Web API ✓
- Mobile App ✗
- Console ✗
- Service ✗
- Desktop App ✗

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Technology Stack

.NET Core has a great support for Web Apps

So…

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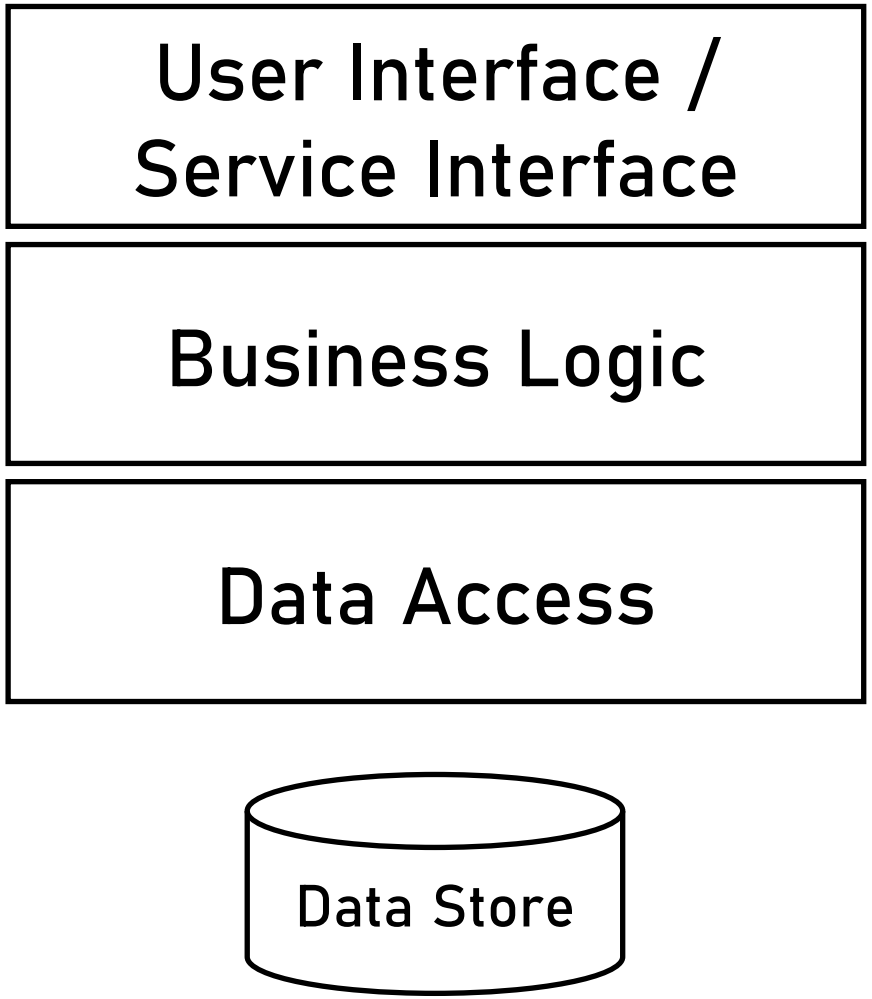
Technology Stack

Architecture



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Architecture

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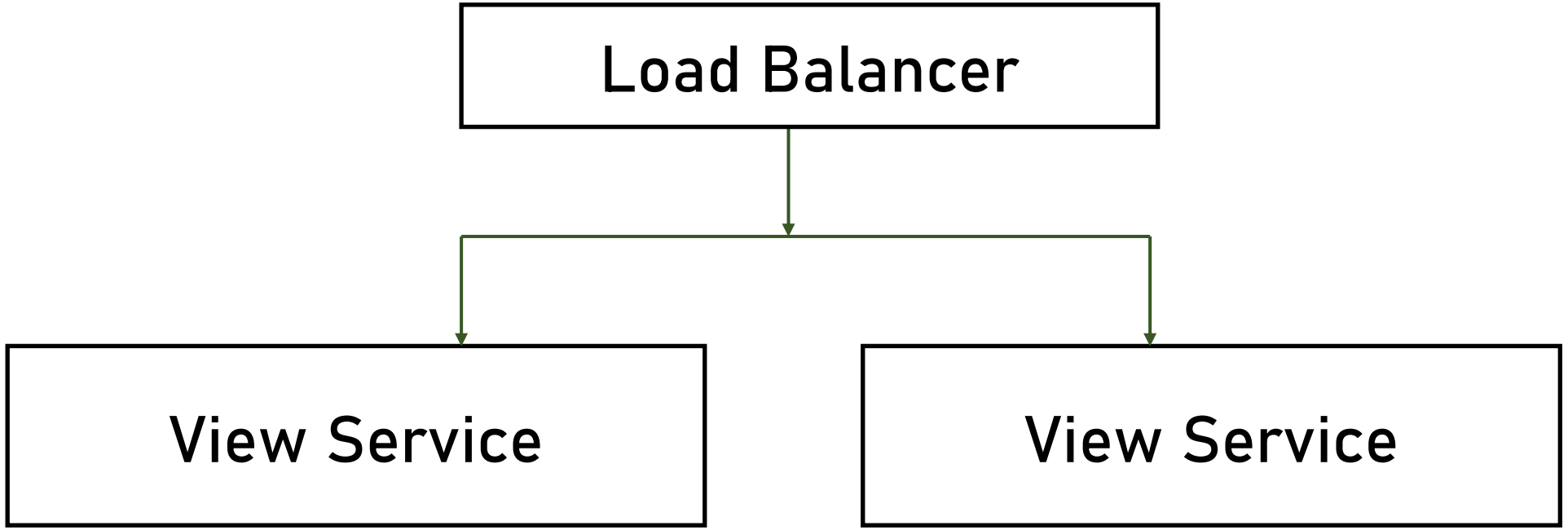
View Service Redundancy



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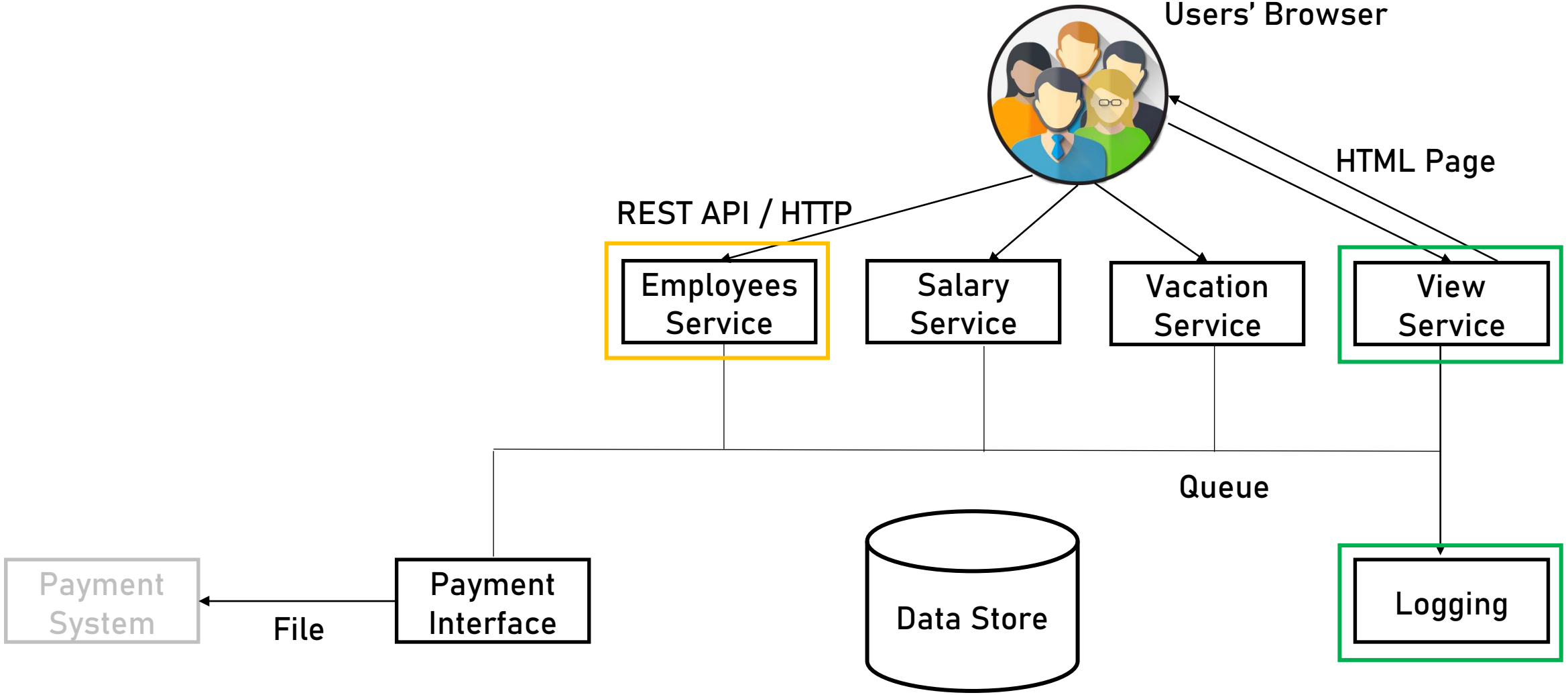
Components



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Employees Service

What it does:

- Allows end users to query employees' data

- Allows performing actions on data (CUD)

What it doesn't:

- Displays the data

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Application Type

- Web App & Web API ✓
- Mobile App ✗
- Console ✗
- Service ✗
- Desktop App ✗

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Technology Stack – Dev Platform

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Technology Stack – Database

Employee Data (Relational)

Documents

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Technology Stack – Database

Document (BLOB) Storage Alternatives

- Relational Database
- File System
- Object Store
- Cloud Storage

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Document (BLOB) Storage Alternatives

Alternative	Description	Examples	Pros	Cons
Relational Database	Store the document in a specialized column type designed for BLOBs	SQL Server's FILESTREAM, Oracle's BLOB type	Part of the app transaction Part of the DB's backup / DR	Clunky syntax, Limited size

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Object Store	Use special type of store mechanism that specializes in BLOBs	CEPH	Great scale Unlimited size	Complex setup Dedicated knowledge New product in the mix

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Object Store	Use special type of store mechanism that specializes in BLOBs	CEPH	Great scale Unlimited size	Complex setup Dedicated knowledge New product in the mix
Cloud Storage	Store the documents in one of the public cloud storage mechanisms	Azure's Storage Account AWS's S3	Great scale Easy to execute	Requires internet connection Cost

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Technology Stack – Database

Employee Data (Relational)

Documents

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Technology Stack – Database

Employee Data (Relational)

- Documents are small (~1MB)
- Already exists
- Part of the app

Documents

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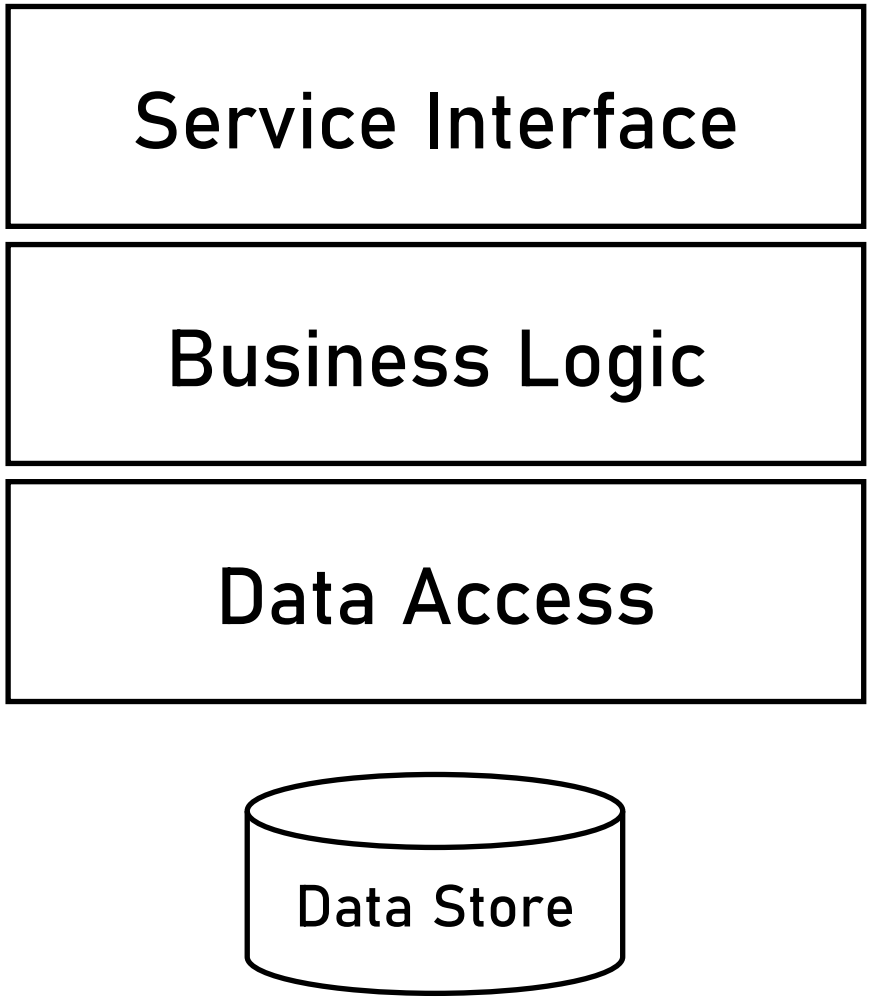
Architecture



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API

- Get full employee details by ID
- List of employees by parameters
- Add employee
- Update employee details
- Remove employee ← Not physical delete!

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API – Cont.

- Add document
- Remove document
- Get document
- Retrieve documents by parameters

Q: Do we need a separate Document Handler service?

A: Since only the Employee entity requires docs, then no.

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API

Functionality	Path	Return Codes
Get employee details by ID	GET /api/v1/employee/*{id}*	200 OK 404 Not Found
List employees by parameters	GET /api/v1/employees?*name=…&birthdate=…*	200 OK 400 Bad Request
Add employee	POST /api/v1/employee	201 Created 400 Bad Request
Update employee details	PUT /api/v1/employee/*{id}*	200 OK 400 Bad Request 404 Not Found
Remove employee	DELETE /api/v1/employee/*{id}*	200 OK 404 Not Found

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API

Functionality	Path	Return Codes
Add document	POST /api/v1/employee/{id}/document	201 Created 404 Not Found
Remove document	DELETE /api/v1/employees/{id}/document/{docid}	200 OK 404 Not Found
Get document	GET /api/v1/employees/{id}/document/{docid}	200 OK 404 Not Found
Retrieve documents for employee	GET /api/v1/employees/{id}/documents	200 OK 404 Not Found

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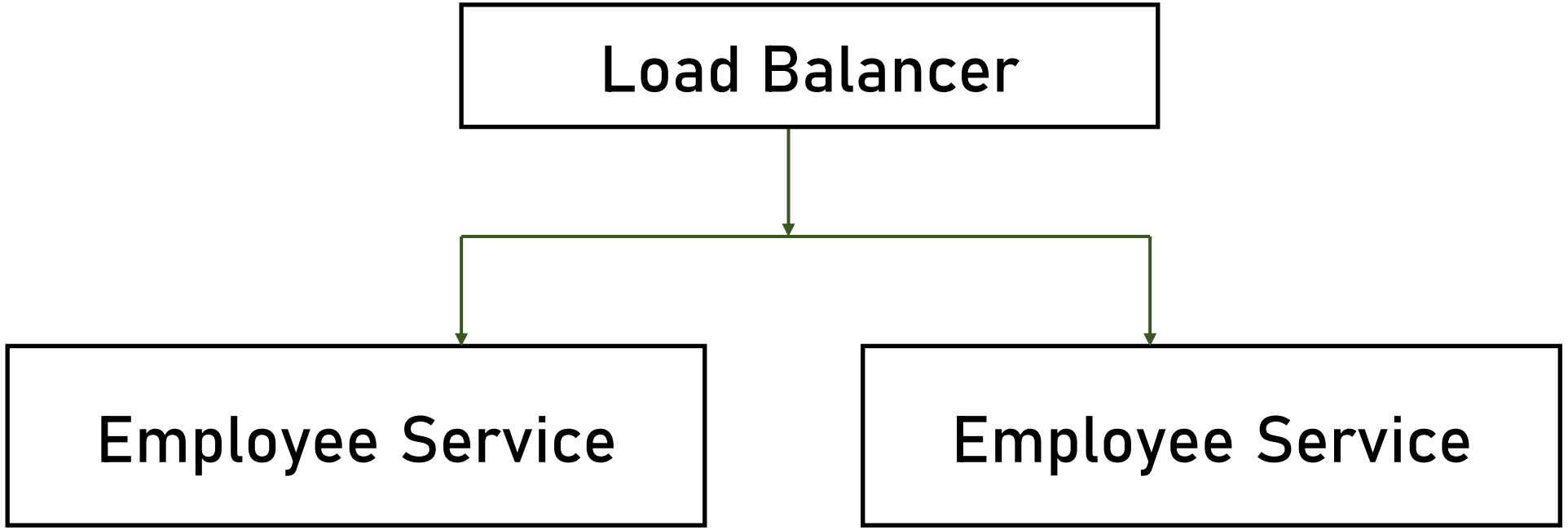
Employee Service Redundancy



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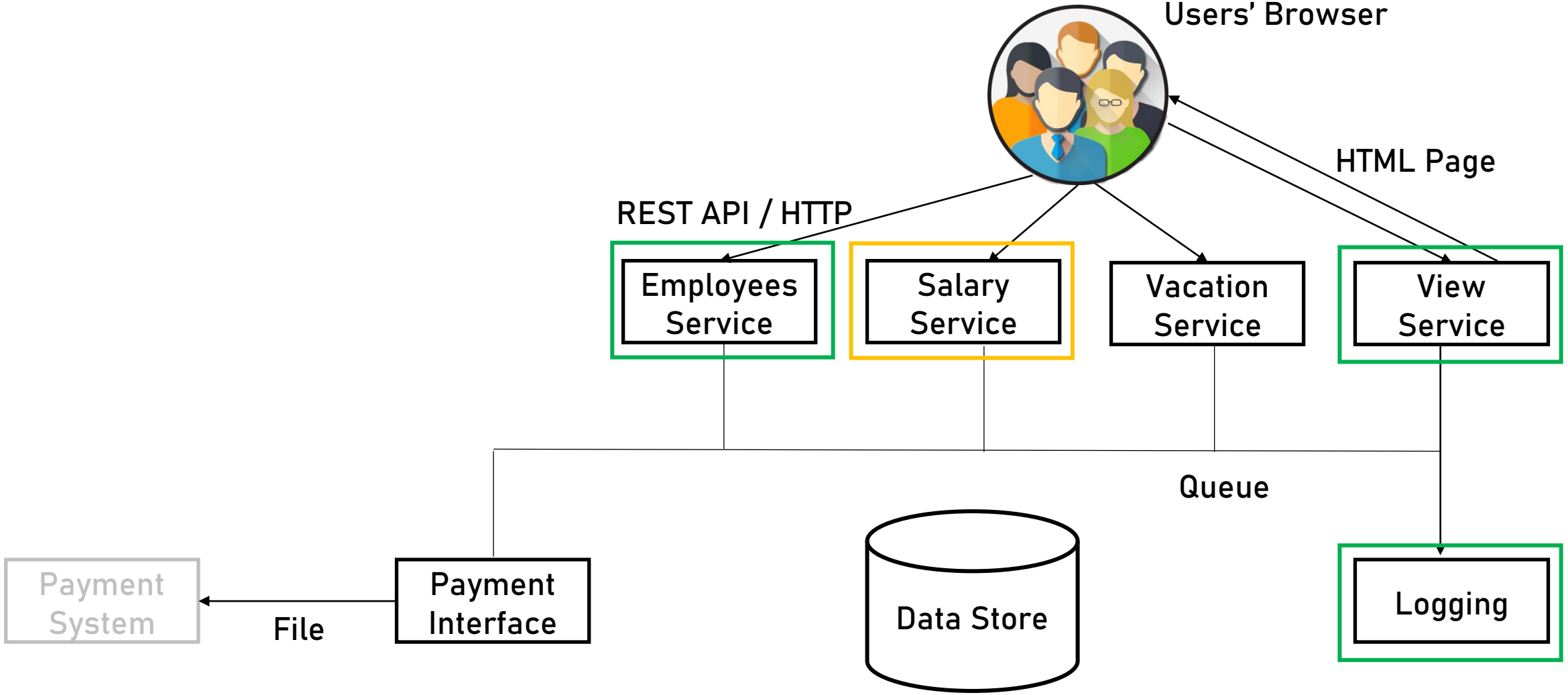
Components



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Salary Service

What it does:

- Allows managers to ask for an employee's salary change
- Allows HR representative to approve / reject the request

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Application Type

- Web App & Web API ✓
- Mobile App ✗
- Console ✗
- Service ✗
- Desktop App ✗

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Technology Stack

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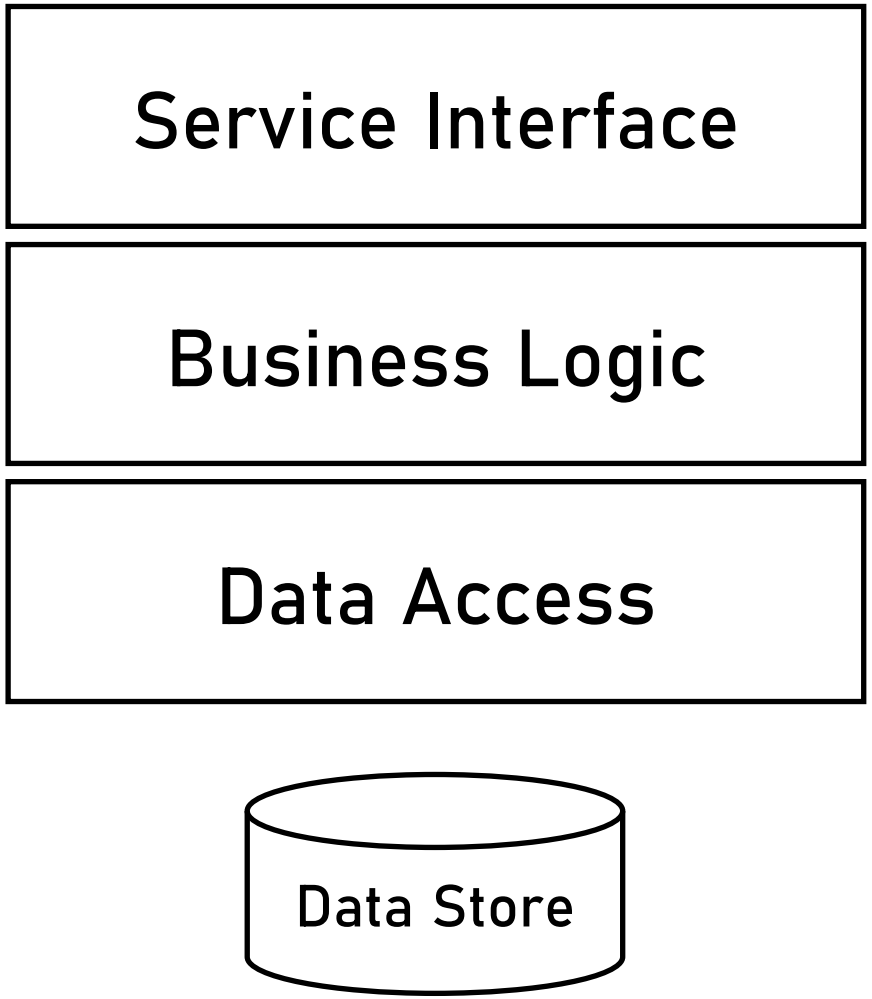
Architecture



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API

- Add salary request
- Remove salary request
- Get salary requests
- Approve salary request
- Reject salary request

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API

Functionality	Path	Return Codes
Add salary request	POST /api/v1/salaryRequest/	200 OK 400 Bad Request
Remove salary request	DELETE /api/v1/salaryRequest/*{id}*	200 OK 404 Not Found
Get salary requests	GET /api/v1/salaryRequests	200 OK
Approve salary request	POST /api/v1/salaryRequest/*{id}*/approval	200 OK 404 Not Found
Reject salary request	POST /api/v1/salaryRequest/*{id}*/rejection	200 OK 404 Not Found

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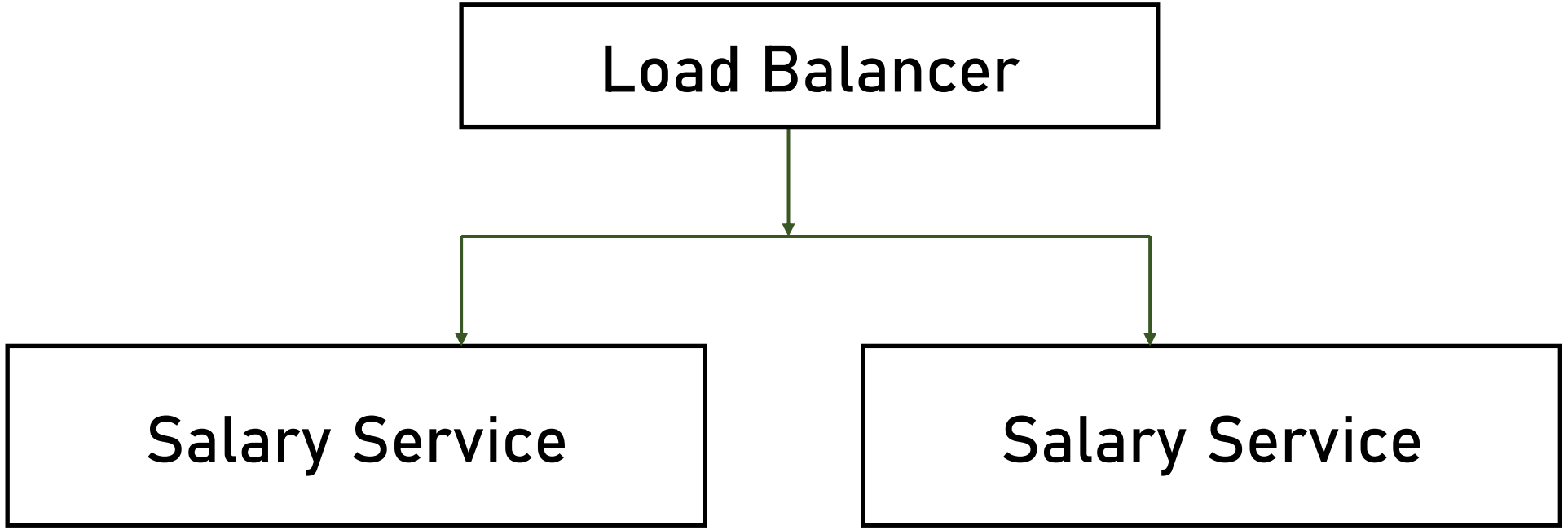
Salary Service Redundancy



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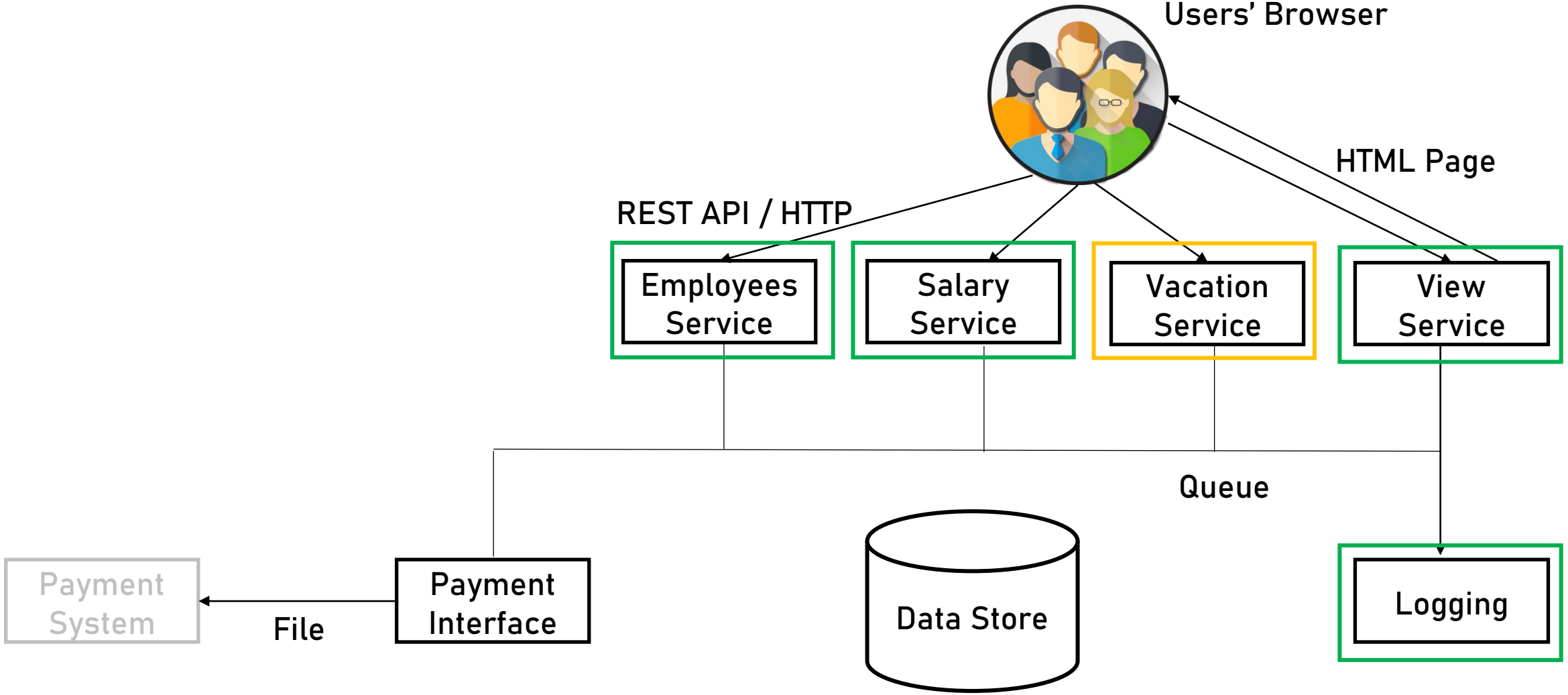
Components



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Vacation Service

What it does:

- Allows employees to manage their vacation days
- Allows HR to set available vacation days for employees

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Application Type

- Web App & Web API ✓
- Mobile App ✗
- Console ✗
- Service ✗
- Desktop App ✗

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Technology Stack

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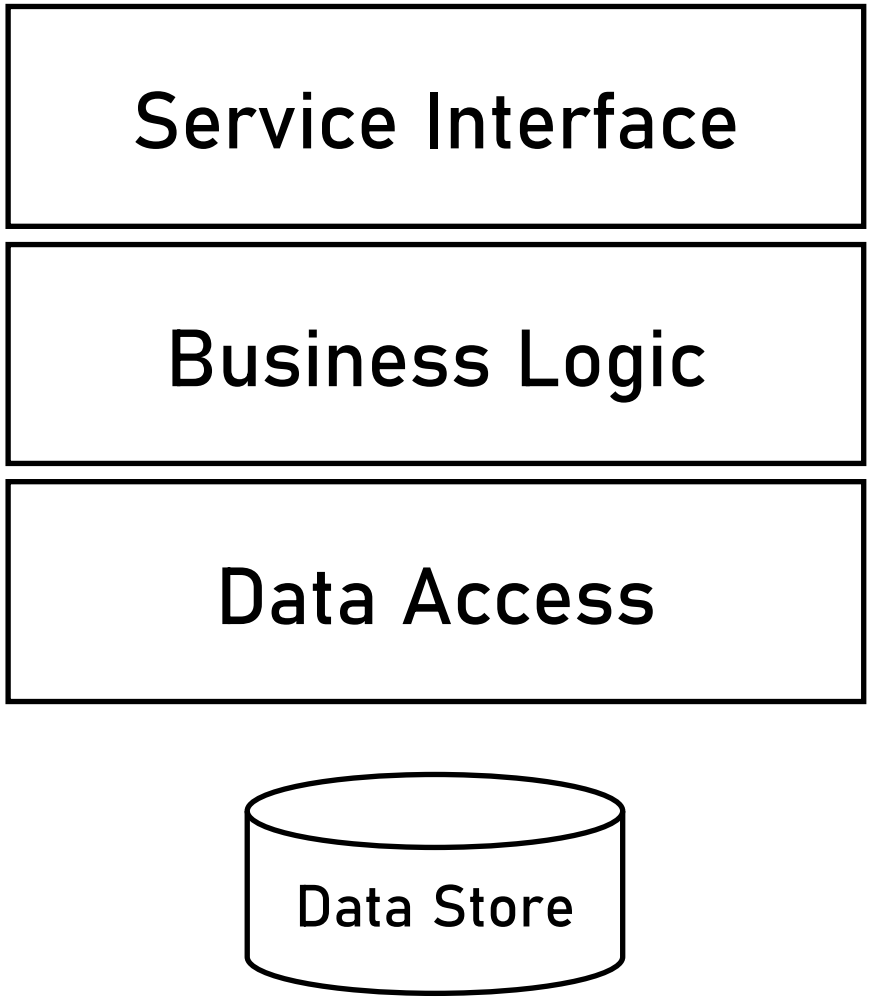
Architecture



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API

- Set available vacation days (by HR)
- Get available vacation days
- Reduce vacation days (by employees)

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API

Functionality	Path	Return Codes
Set available vacation days	PUT /api/v1/vacation/*{empid}*	200 OK 404 Not Found
Get available vacation days	GET /api/v1/vacation/*{empid}*	200 OK 404 Not Found
Reduce vacation days	POST /api/v1/vacation/*{empid}*/reduction	200 OK

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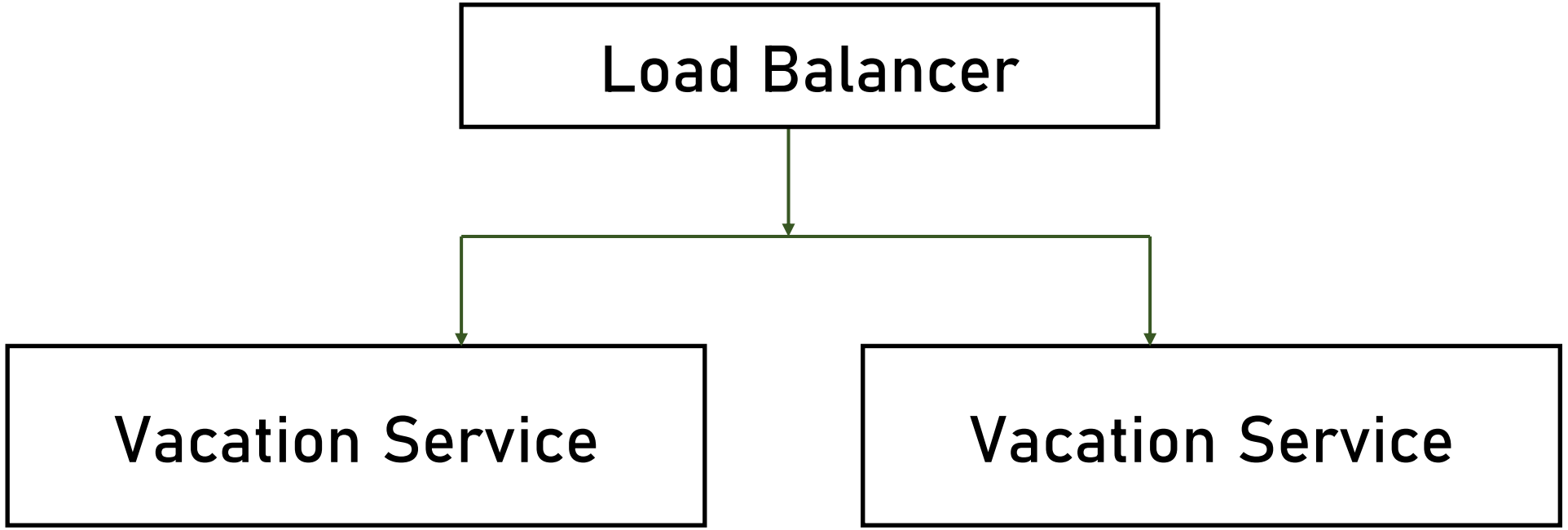
Vacation Service Redundancy



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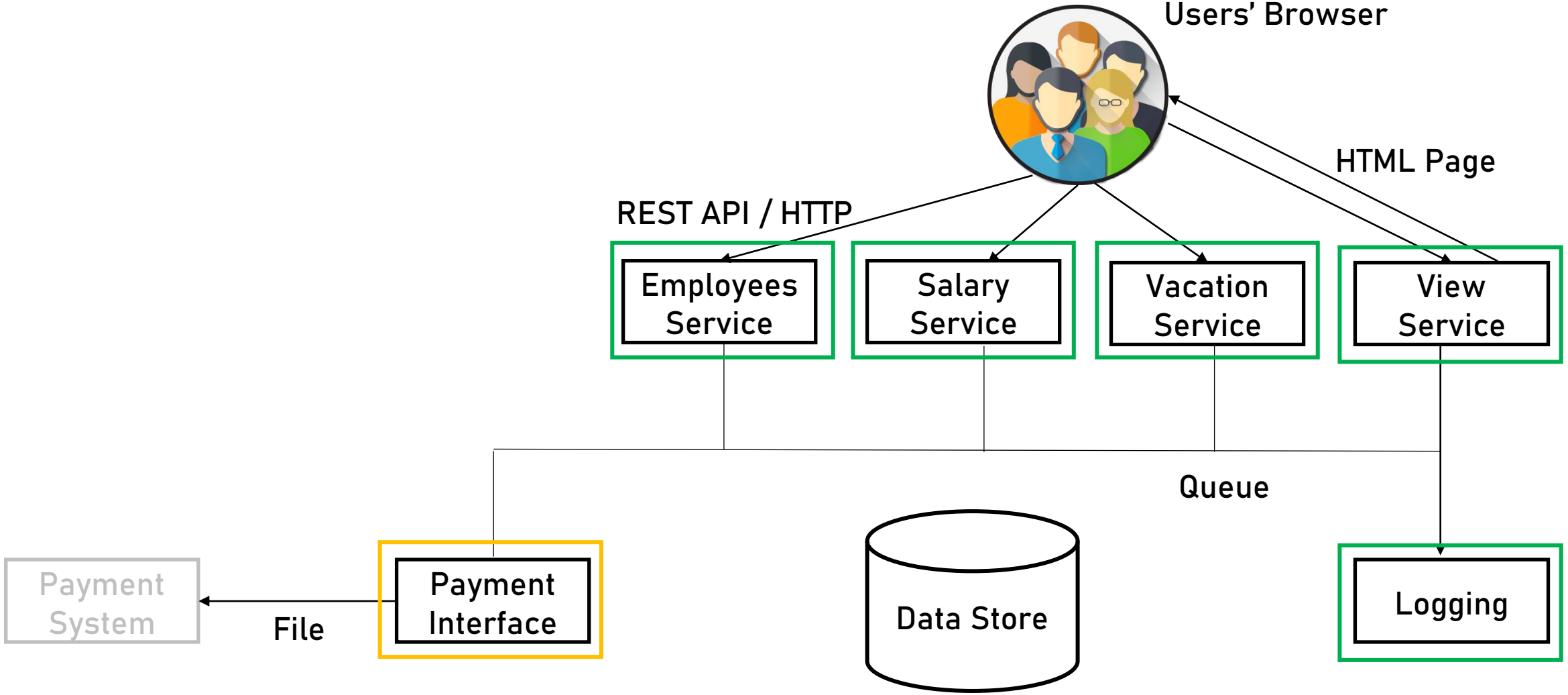
Components



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Payment Interface

What it does:

- Queries the database once a month for salary data
- Passes payment data to the external payment system

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Application Type

- Web App & Web API ✗
- Mobile App ✗
- Console ✗
- Service ✓
- Desktop App ✗

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Technology Stack

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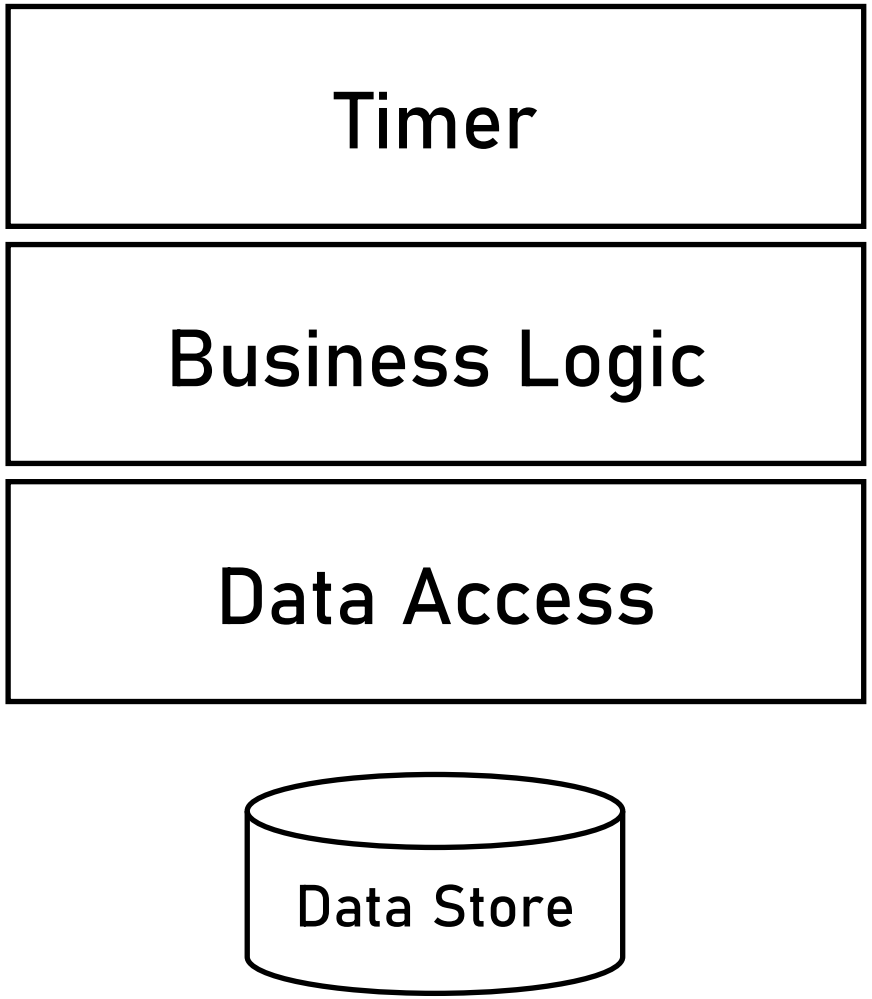
Architecture



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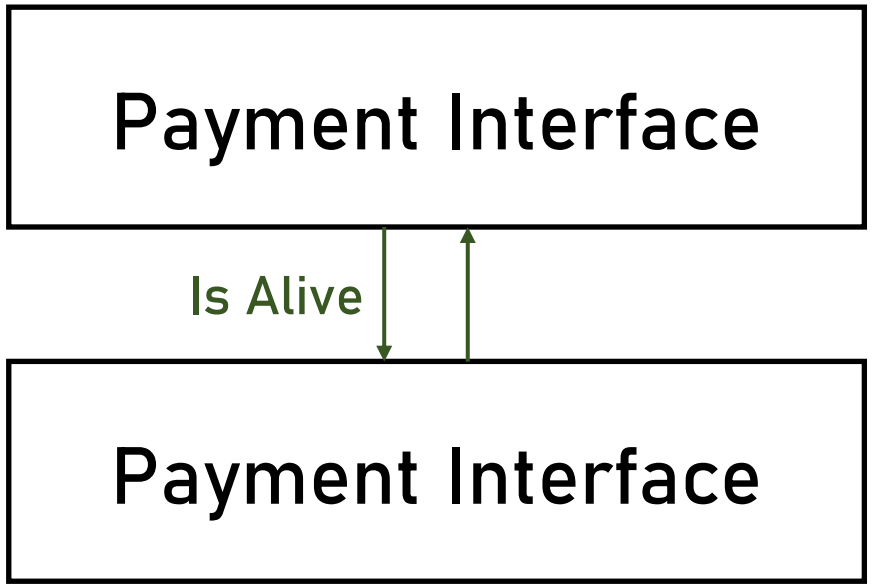
Payment Interface Redundancy



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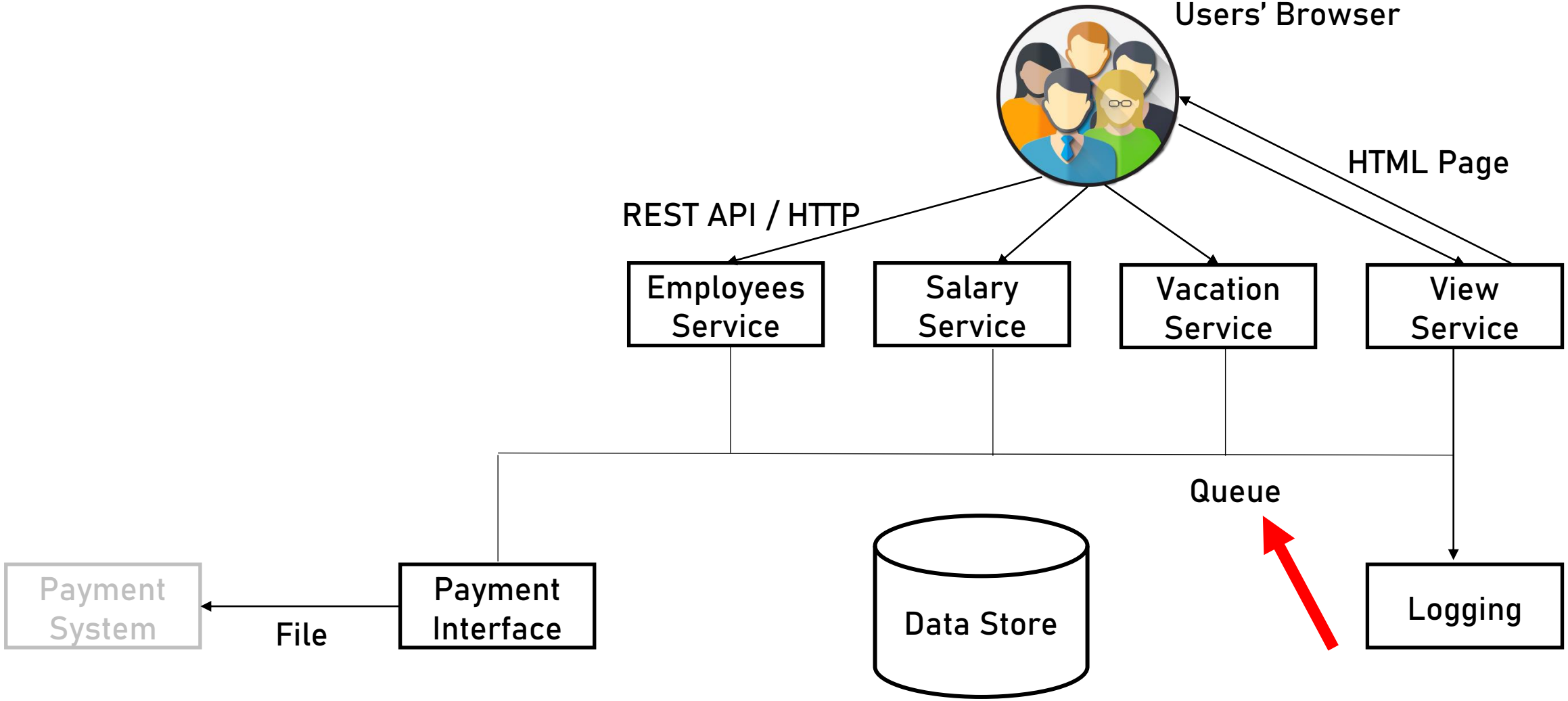
Messaging



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Technology Stack – Queue

Queue Alternatives:

- ~~Self Developed~~
- RabbitMQ
- Kafka

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Alternative	Description	Pros
Rabbit MQ	General purpose message-broker engine	Easy to setup Easy to use

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Alternative	Description	Pros
Rabbit MQ	General purpose message-broker engine	Easy to setup Easy to use
Apache Kafka	Stream processing platform	Perfect for data intensive scenarios

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Technology Stack – Queue

Queue Alternatives:

- Self Developed
- RabbitMQ
- Kafka

- No data stream involved
- Easy to use

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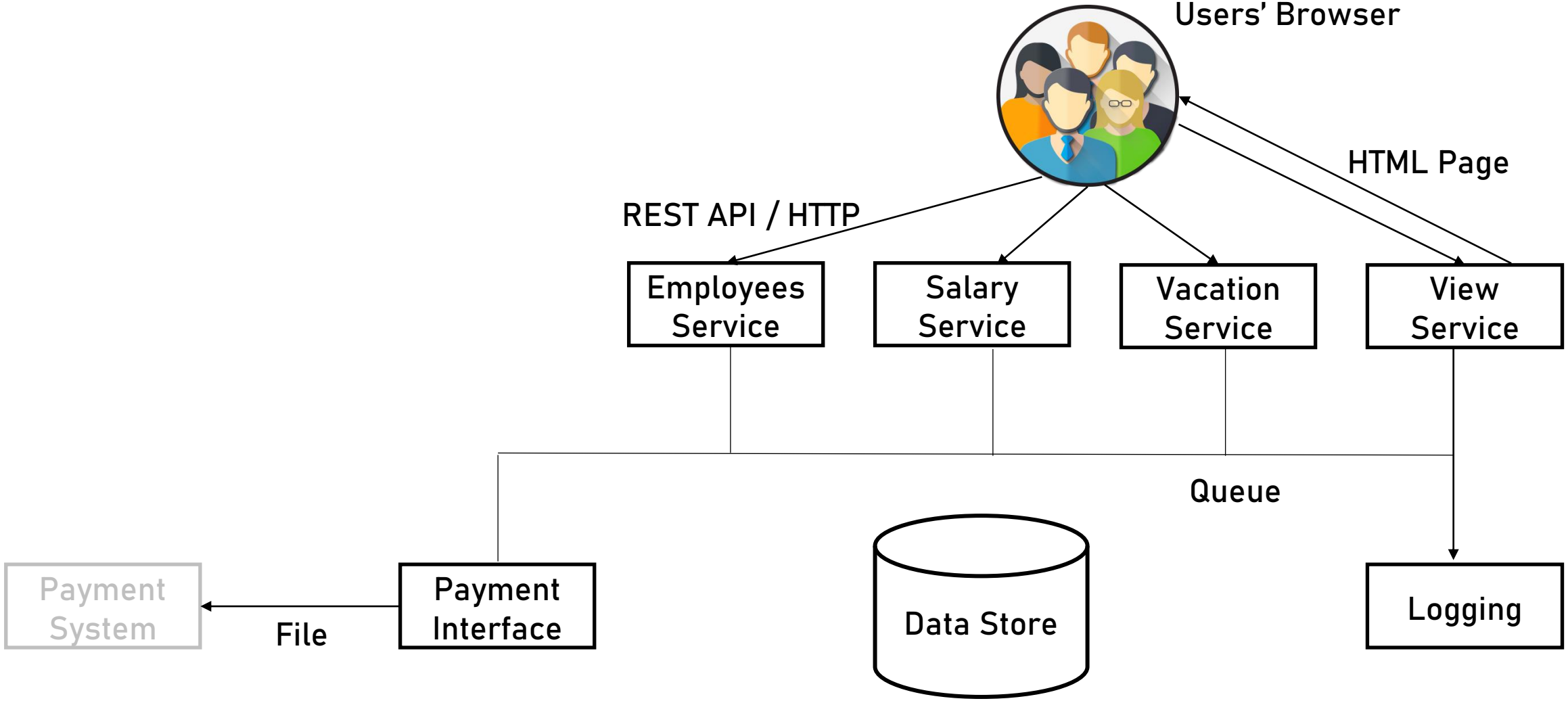
Logic Diagram



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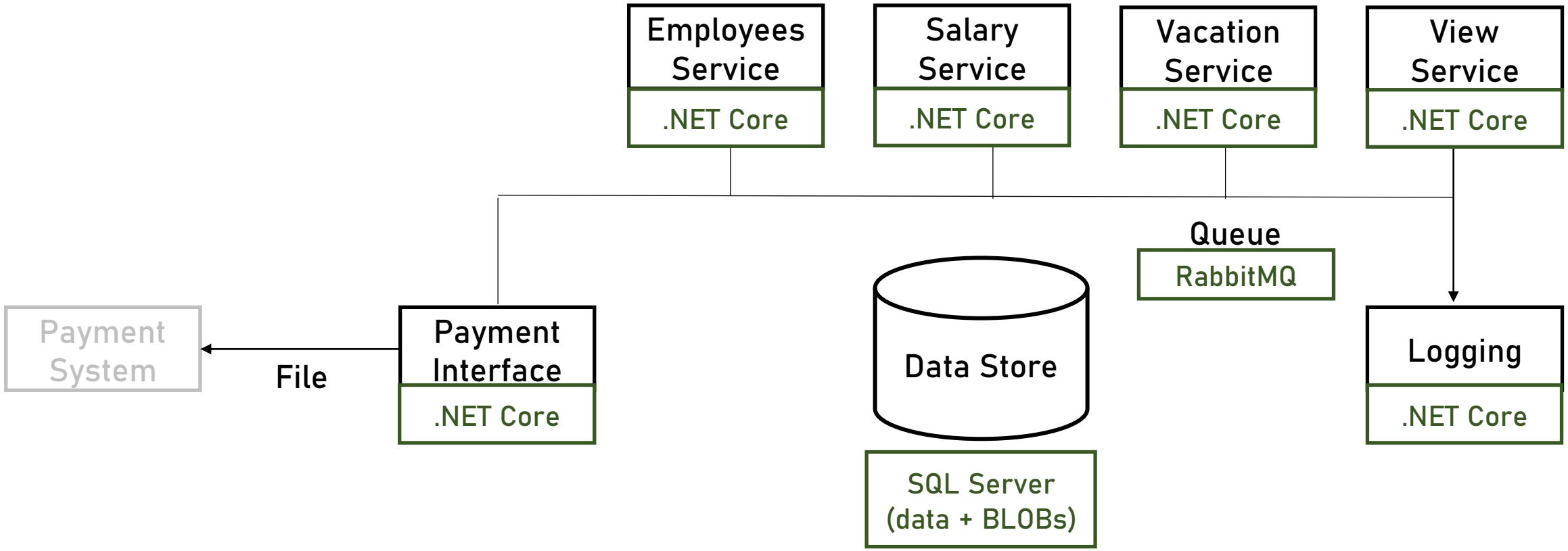
Technical Diagram



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Physical Diagram